UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

FEDERAL HOUSING FINANCE AGENCY, AS CONSERVATOR FOR THE FEDERAL NATIONAL MORTGAGE ASSOCIATION AND THE FEDERAL HOME LOAN MORTGAGE CORPORATION, Plaintiff, -against- JPMORGAN CHASE & CO., et al., Defendants.	**Expert Report Of Charles D. Cowan, Ph.D. Regarding The Selection Of Statistically Valid Random Samples Of Mortgage Loans for Fifteen FHFA Actions** 11 Civ. 6188 (DLC)
FEDERAL HOUSING FINANCE AGENCY, AS CONSERVATOR FOR THE FEDERAL NATIONAL MORTGAGE ASSOCIATION AND THE FEDERAL HOME LOAN MORTGAGE CORPORATION, Plaintiff, -against- HSBC NORTH AMERICA HOLDINGS, INC., et al., Defendants.	11 Civ. 6189 (DLC)
FEDERAL HOUSING FINANCE AGENCY, AS CONSERVATOR FOR THE FEDERAL NATIONAL MORTGAGE ASSOCIATION AND THE FEDERAL HOME LOAN MORTGAGE CORPORATION, Plaintiff, -against- BARCLAYS BANK PLC, et al., Defendants.	11 Civ. 6190 (DLC)

FEDERAL HOUSING FINANCE AGENCY, AS CONSERVATOR FOR THE FEDERAL NATIONAL MORTGAGE ASSOCIATION AND THE FEDERAL HOME LOAN MORTGAGE CORPORATION, Plaintiff, -against- DEUTSCHE BANK AG, et al., Defendants.	11 Civ. 6192 (DLC)
FEDERAL HOUSING FINANCE AGENCY, AS CONSERVATOR FOR THE FEDERAL NATIONAL MORTGAGE ASSOCIATION AND THE FEDERAL HOME LOAN MORTGAGE CORPORATION, Plaintiff, -against- FIRST HORIZON NATIONAL CORP., et al., Defendants.	11 Civ. 6193 (DLC)
FEDERAL HOUSING FINANCE AGENCY, AS CONSERVATOR FOR THE FEDERAL NATIONAL MORTGAGE ASSOCIATION AND THE FEDERAL HOME LOAN MORTGAGE CORPORATION, Plaintiff, -against- BANK OF AMERICA CORP., et al., Defendants.	11 Civ. 6195 (DLC)

FEDERAL HOUSING FINANCE AGENCY, AS CONSERVATOR FOR THE FEDERAL NATIONAL MORTGAGE ASSOCIATION AND THE FEDERAL HOME LOAN MORTGAGE CORPORATION, Plaintiff, -against- CITIGROUP INC., et al., Defendants.	11 Civ. 6196 (DLC)
FEDERAL HOUSING FINANCE AGENCY, AS CONSERVATOR FOR THE FEDERAL NATIONAL MORTGAGE ASSOCIATION AND THE FEDERAL HOME LOAN MORTGAGE CORPORATION, Plaintiff, -against- GOLDMAN, SACHS & CO., et al., Defendants.	11 Civ. 6198 (DLC)
FEDERAL HOUSING FINANCE AGENCY, AS CONSERVATOR FOR THE FEDERAL NATIONAL MORTGAGE ASSOCIATION AND THE FEDERAL HOME LOAN MORTGAGE CORPORATION, Plaintiff, -against- CREDIT SUISSE HOLDINGS (USA), INC., et al., Defendants.	11 Civ. 6200 (DLC)

FEDERAL HOUSING FINANCE AGENCY, AS CONSERVATOR FOR THE FEDERAL NATIONAL MORTGAGE ASSOCIATION AND THE FEDERAL HOME LOAN MORTGAGE CORPORATION, Plaintiff, -against- NOMURA HOLDING AMERICA, INC., et al., Defendants.	11 Civ. 6201 (DLC)
FEDERAL HOUSING FINANCE AGENCY, AS CONSERVATOR FOR THE FEDERAL NATIONAL MORTGAGE ASSOCIATION AND THE FEDERAL HOME LOAN MORTGAGE CORPORATION, Plaintiff, -against- MERRILL LYNCH & CO., INC., et al., Defendants.	11 Civ. 6202 (DLC)
FEDERAL HOUSING FINANCE AGENCY, AS CONSERVATOR FOR THE FEDERAL NATIONAL MORTGAGE ASSOCIATION AND THE FEDERAL HOME LOAN MORTGAGE CORPORATION, Plaintiff, -against- SG AMERICAS, INC., et al., Defendants.	11 Civ. 6203 (DLC)

FEDERAL HOUSING FINANCE AGENCY, AS CONSERVATOR FOR THE FEDERAL NATIONAL MORTGAGE ASSOCIATION AND THE FEDERAL HOME LOAN MORTGAGE CORPORATION, Plaintiff, -against- MORGAN STANLEY, et al., Defendants.	11 Civ. 6739 (DLC)
FEDERAL HOUSING FINANCE AGENCY, AS CONSERVATOR FOR THE FEDERAL NATIONAL MORTGAGE ASSOCIATION AND THE FEDERAL HOME LOAN MORTGAGE CORPORATION, Plaintiff, -against- ALLY FINANCIAL INC., et al., Defendants.	11 Civ. 7010 (DLC)
FEDERAL HOUSING FINANCE AGENCY, AS CONSERVATOR FOR THE FEDERAL NATIONAL MORTGAGE ASSOCIATION AND THE FEDERAL HOME LOAN MORTGAGE CORPORATION, Plaintiff, -against- GENERAL ELECTRIC COMPANY, et al., Defendants.	11 Civ. 7048 (DLC)

Expert Report Of Charles D. Cowan, Ph.D. Regarding The Selection Of Statistically Valid Random Samples Of Mortgage Loans for Fifteen FHFA Actions

October 10, 2012

I. Introduction

1. I have been retained by Quinn Emanuel Urquhart & Sullivan, LLP and Kasowitz, Benson, Torres & Friedman LLP, counsel for Plaintiff Federal Housing Finance Agency ("FHFA"), to develop a methodology to select a statistically valid random sample of loans from the Supporting Loan Groups (the "SLGs") backing the Certificates purchased by The Federal National Mortgage Association ("Fannie Mae") and The Federal Home Loan Mortgage Corporation ("Freddie Mac," and, together with Fannie Mae, the "Government Sponsored Enterprises" or "GSEs") from each of the 449 securitizations of loans (the "Securitizations") at issue in the sixteen coordinated FHFA actions (the "FHFA Litigations").[1]

2. Statistical sampling is a common and scientifically accepted methodology used for research and other purposes, including in legal proceedings. Courts routinely rely on statistical sampling to establish liability and damages. Moreover, statistical sampling, as a scientific methodology, has been generally accepted in the scientific community for over a hundred years. There is a wide body of peer-reviewed literature in the field of statistics that discusses the utility of using statistical sampling to estimate results in a particular population based on results from a sample of that population. There have been countless applications of statistical sampling in academia, government, and business.

3. Statistical sampling has been used to value and assess portfolios of loans by the government and businesses alike. For example, federal regulators often examine a sample of loans held by financial institutions to determine whether the financial institution is in compliance with its statutory and regulatory requirements. Similarly, private businesses routinely use

[1] FHFA previously submitted the Expert Report of Charles D. Cowan, Ph.D. Regarding The Selection of Statistically Valid Random Samples Of Mortgage Loans, dated August 9, 2012 in *FHFA v. UBS*, 11 Civ. 5201 (DLC) (the "UBS Report"). This Report addresses a sampling methodology for the fifteen other cases in the FHFA Litigations.

sampling to review and assess pools of mortgage loans, for example, to assess credit quality, compliance with regulatory requirements and other laws, and adherence to internal policies and procedures.

4. I have chosen a random sample of 100 loans from the populations of loans in the SLG(s) in each of the 449 Securitizations (the "Populations"). This sample is sufficiently large to draw conclusions about the Populations and specifically to make a scientifically valid estimate of the number of loans in each Population about which Defendants made untrue statements or omissions in the Prospectus Supplements for the Securitizations. Regardless of the number of loans in each Population, this sample size is based on a 95 percent confidence level, which is standard in statistics and has been accepted as such by Defendants' expert Arnold Barnett, Ph.D.,[2] with, at maximum, a margin of error of +/- 10 percent. In addition, I have stratified the loans in each Population by credit score (when available), which may reduce that margin of error. An increase in sample size to reduce the margin of error would not significantly improve the determination of whether the Defendants' statements in the Prospectus Supplements were false. Such an increase in sample size would yield diminishing returns. Likewise, use of additional stratification variables would not necessarily reduce the margin of error and could introduce other issues complicating the extrapolation of the sample to the population.

5. These samples are representative of the populations and are unbiased. I have tested the representativeness of the proposed samples against the Populations on eleven key variables (when available) from the loan tapes,[3] which allows me to confirm a high level of

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[2] *See* Declaration of Arnold Barnett, Ph.D., dated June 7, 2012 ("Barnett Decl.") at ¶¶ 13(c) & 44.

[3] Loan tapes are collections of data concerning the individual loans in the Securitizations compiled by the RMBS Sponsors while the Securitization is being created. These tapes typically include the loan-to-value ratio, the borrower's credit score, and the borrower's

correspondence between the characteristics of the sampled loans and the corresponding Populations. Once the re-underwriting of the loan files is complete, I will be able to extrapolate from the samples to the populations using established methods.

II. Professional Qualifications and Compensation

6. I have over forty years of experience in statistical research and design. I received my Bachelor of Arts degree in Economics from the University of Michigan, my Master of Arts degree in Economics from the University of Michigan, and my doctorate in Mathematical Statistics from the George Washington University. I currently consult for numerous public and private sector entities on the design, implementation, and evaluation of research, and the synthesis of statistical and sampling techniques for measurement. My professional experience and academic tenures are included in my curriculum vitae, a true and correct copy of which is attached as Exhibit 1.

A. Professional Experience

7. I have designed some of the largest and most complex research programs incorporating sampling that were conducted by the federal government and incorporating sampling, including: the Post Enumeration Program conducted by the Bureau of the Census to evaluate the 1980 Decennial Census, the Economic Cash Recovery valuations conducted by the Resolution Trust Corporation ("RTC") from 1990 to 1995, and many evaluation studies conducted for the Department of Justice, the Department of Defense, the Department of Housing and Urban Development ("HUD"), and the Department of Treasury.

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occupancy status. The final version of the loan tape, which is what I used where available, is also known as the Mortgage Loan Schedule. As explained in paragraph 50 below, where the data on the loan tapes was incomplete or unreliable, I supplemented it with data from CoreLogic, a widely recognized provider of financial data.

8. I have also provided expert advice to corporations and government agencies on the incorporation of complex research designs in demographic and economic measurement problems. My most significant matters include the following:

- Development of procedures used by the RTC and the Federal Deposit Insurance Corporation ("FDIC") for determining the value of all assets held by the RTC/FDIC taken from failed banks and savings and loan associations. This involved sampling and reviewing 10,000 loans per quarter to determine their value. Results from the extrapolation of the samples were used in quarterly reports to Congress on the loss to the American taxpayer that resulted from these failures. The RTC and FDIC also used these estimates of anticipated recoveries on assets for financial reporting. As a result of this work, the Government Accounting Office awarded these agencies their first clean opinions from its annual review of agency financial statements.

- Application of econometric and biometric procedures for measuring credit risk in large portfolios of loans for the FDIC, Regions Bank, Option One, and Providian. Frequently these model-based techniques are combined with the results of sample reviews to improve the reliability of evaluations of portfolios. These models are used for a variety of purposes within financial institutions, such as the pricing of loans, the long-term management of customers, decision-making on workouts for delinquent loans, and the establishment of economic and regulatory reserves.

- Model fitting and development of projection methods for the FDIC and PricewaterhouseCoopers to measure the likelihood of loss or errors in recording loans held by banks or put up for auction; measurement of the likelihood of fraud and/or noncompliance in systems, including bank holding companies, trading activities for brokers, and systems for compliance with health department and judicial requirements. These model-based techniques are combined with the results of sample reviews to improve the reliability of evaluations of portfolios.

- Establishment of audit and sampling methods to determine the completeness and accuracy of reporting and record systems. These procedures are used to both expand and streamline bank examinations for safety and soundness and also compliance measurement for the FDIC. These sampling techniques are applied in the audit of federal agencies concerned with regulatory review of operations and systems, and related systems for banks, regulatory agencies, and law firms.

- Evaluation of sample surveys conducted for the Department of Defense, the National Institutes of Health, the Department of Agriculture, the Department of Education, and the Treasury, each in response to Congressional inquiries on the validity of results in reports to Congress on activities in these agencies.

- Development of procedures used by the Bureau of the Census to apportion the population for revenue sharing purposes and to estimate the undercount in the Decennial Census of

Population and Housing. These procedures include application of sample-based, capture-recapture methods to measure the size of the undercount in the decennial census, use of network sampling as an alternative measure for population size, and measurement of the accuracy of data collected in the Census.

- Development of statistical methods to quantify the size of populations, including nomadic populations for the Census of Somalia, the under-count and over-count in the Census of Egypt, the number of missing children in Chicago, Illinois, and the number of homeless persons and families needing services in several large cities with transient populations.

9. Since January 2002 to the present, I have been the Managing Partner of Analytic Focus, LLC. My firm provides expert witness and consulting services in litigation. My firm also has several non-litigation projects with the federal government, and has assisted banks in evaluating the value and stability of their loan portfolios. My most significant matters include the following:

- I serve as a sampling expert in *MBIA Ins. Corp. v. Countrywide Home Loans, Inc., et al.*, Index No. 602825/2008 (N.Y. Sup. Ct. Aug. 24, 2009), a case pending in the Supreme Court of the State of New York and involving allegations of material misrepresentations and omissions regarding loan characteristics that are similar to the allegations in these matters. In *Countrywide*, I constructed for Plaintiff MBIA statistically valid random samples of mortgage loans from over 368,000 loans underlying 15 securitizations. In 2010, the court accepted the sampling and extrapolation methodology that I formulated, and the samples have been used as the basis for re-underwriting review and to estimate damages.

- I serve as a statistical expert in *In re Washington Mutual Mortgage Backed Securities Litigation*, No. C09-37 MJP (W.D. Wash. July 23, 2012), which is also an RMBS action, pending in federal court in the Western District of Washington. In *Washington Mutual*, I constructed a statistically valid random sample of mortgage loans from 13,425 mortgage loans underlying six offerings. In July of this year, the court accepted the sampling and extrapolation methodology that I proposed on behalf of Plaintiffs Policemen's Annuity and Benefit Fund of the City of Chicago and Boilermakers National Annuity Trust. The samples have been used as the basis for re-underwriting review, and my extrapolation was admitted as evidence of liability.

- From 2003-2005, for Regions Bank, I took a sample of small business loans and evaluated the safety ratings that Regions Bank had assigned to these loans. Regions Bank relied on my work to pass an examination and review conducted by the Federal Reserve and the FDIC, in their capacity as regulators of the bank.

- For Option One, a mortgage originator, I evaluated in 2001-2002 their portfolio of loans and developed models to forecast prepay and default rates for residential mortgages.

- For the FDIC, from 2002 to 2006, I selected samples of depositor records from a sample of banks that had been closed between 1990 and 2002, and conducted an analysis of the amount of time and effort required to close a very large bank and the problems associated with paying off depositors. This work was used by the FDIC to streamline the processes it used to close banks and to pay depositors.

- For the Office of Personnel Management ("OPM"), from 2004 to the present, I redesigned the sampling system used by the OPM and KPMG for the audit of the Civil Service Retirement System and the Federal Employee Retirement System. Each year, I am responsible for sampling records from four funding systems used by OPM to determine the safety and soundness of these funds. My reports also are used to fulfill the requirements of the Improper Payments Act.

- In 2010 and 2011, I developed a methodology for the National Institutes of Health ("NIH") for the construction of sampling frames of physicians, health workers, and others involved in health related fields. My report, published by the NIH, serves as guidance to all 23 NIH agencies on methods for sample frame construction, sampling, and estimation for any research conducted by the NIH.

- From 2006 to the present, I have maintained a staff responsible for all quality control on litigation support work done by outside vendors hired by the Department of Justice in civil cases. This staff designs and implements sampling plans that are used to conduct the quality control assessments.

- For the Small Business Administration, I conducted a 2005 study involving a sample of banks used to determine the manner in which banks evaluate the credit-worthiness of small businesses. The data from my research has been used by the Federal Reserve in its review of credit availability to small businesses and by the House Subcommittee on Banking.

- I have been retained as an expert witness or consultant in connection with litigation involving antitrust claims, deceptive sales practices, environmental toxic tort, insurance and reinsurance, trademark and trade dress confusion, and class actions on behalf of defendants and plaintiffs. I frequently rely on statistical sampling in cases as disparate as wrongful death cases and antitrust cases.

10. From November 1999 to December 2001, I was a Director at the Analysis Research Planning Corporation ("ARPC"), an economic and management consulting firm that provides statistical, econometric, economic and financial analysis, strategic advice and expert testimony to a wide variety of clients facing uncertainty, potential litigation or disputes. My work involved the development of new forecasting models for present and future claims in asbestos cases, and the analysis of alleged diminution of value in toxic tort cases.

11. From January 1997 to November 1999, I was a Director at Pricewaterhouse Coopers, LLP responsible for managing the financial research group in the Survey Research Center ("SRC") and in the Data Mining Group. Research efforts in the SRC were in support of business-to-business consumer research and for the federal government to research regulatory impact. The Data Mining Group provided fraud detection services for financial services organizations, optimization research for businesses concerned with supply chain issues in production, and analysis of delivery systems for a number of major delivery companies.

12. From 1991 to 1996, I was the Chief Statistician for the FDIC and the RTC. During this time, I was responsible for all research on valuation of properties and assets taken in by the FDIC and RTC in the banking crisis of the 1980's and 1990's. I supported research concerning fraud, optimization of contracts with servicing companies, and consumer perceptions of their interactions with banks and savings and loans. I designed the sampling processes used for routine bank examinations, the sampling processes for banks under consideration for closure, and sampling processes for bank resolutions where the bank was closed and sold to an acquiring bank. I prepared and jointly presented results on the FDIC's consumer research to Congress, specifically the House Banking Committee, in hearings regarding how consumers perceive what they are told regarding retail transactions in banks.

13. During this time, I also served on a number of independent review committees for different federal agencies to evaluate the quality of research conducted or proposed by the National Institutes of Health, the Department of Health and Human Services, the Department of Justice, the Department of Treasury, and the Department of Agriculture. These committees were formed specifically to determine whether research presented to the federal government could

support conclusions drawn and to consider whether research proposed in grant applications would be adequate to study the topic in question.

14. From 1989 to 1991, I was the Chief Statistician for the Opinion Research Corporation (the "ORC"). At the ORC, I designed samples and analytic methods by which financial institutions could incorporate external information in aid of their efforts to increase deposits and marketing of non-FDIC-insured products. I also designed the sampling and estimation procedures used by the U.S. Postal Service to measure operational efficiency and consumer satisfaction for all post offices in the United States.

15. From 1986 through 1989, I was the first Chief Statistician for the National Center for Education Statistics ("NCES"), an agency within the Department of Education. As the Chief Statistician, I was responsible for the design of all surveys and research conducted by NCES, for reports to Congress on the state of education in the U.S. and around the world, and for staff development in research methods. In particular, under my guidance, NCES was one of the first federal statistical agencies to publish standards for operations and research. These standards are still mandatory for NCES staff and for all contractors working with the NCES.

16. I also held a variety of positions at the U.S. Bureau of the Census, including Chief of the Survey Design Branch, where I was responsible for the technical aspects of all research conducted on the evaluation of surveys and the 1980 Decennial Census. I also designed research studies on the validity of surveys conducted by the Census Bureau and experiments to measure response validity. I helped a number of countries develop evaluation protocols for their economic and demographic research programs.

B. Experience In Academia

17. I teach graduate and undergraduate courses in sampling theory, survey methods, statistics, and computer methods for analysis. I am currently an Adjunct Full Professor in the

Department of Biostatistics in the School of Public Health at the University of Alabama in Birmingham, Alabama.

18. I also served as an Associate Professor of Statistics at George Washington University from 1993 to 1998, and served as a Visiting Research Professor at the Survey Research Laboratory of the University of Illinois from 1983 to 1989.

C. Publications

19. I have co-authored two books: one on evaluation of survey and census methods and one on econometric measures related to the welfare of the U.S. economy. I also have written numerous articles on statistical methods, sampling, rare and elusive population research, and optimization techniques. A listing of these publications is included at pages 4-7 of my curriculum vitae, attached as Exhibit 1.

20. A number of these publications pertain to the use of statistical sampling and\or financial analysis in connection with lending institutions and loans. *See* Adrian M. Cowan & Charles D. Cowan, *Default Correlation: An Empirical Investigation of a Subprime Lender*, J. Banking & Fin., (2004); Charles D. Cowan & Adrian M. Cowan, *A Survey Based Assessment of Financial Institution Use of Credit Scoring for Small Business Lending*, Small Bus. Res. Summary (U.S. Small Bus. Admin. Office of Advocacy, Wash. D.C.), Nov. 2006; Adrian M. Cowan & Charles D. Cowan, *The Dynamics of Credit Quality and Implications for the Pricing of Small Business Loans*, 5 Int'l J. Banking & Fin., 31 (2008).

D. Professional Societies

21. I am a member of the following professional societies: (i) American Statistical Association ("ASA"); (ii) American Association for Public Opinion Research ("AAPOR"); and (iii) International Association of Assessment Officers. My positions on various professional committees are listed on page 3 of my curriculum vitae, attached as Exhibit 1.

22. I have held a number of positions with the ASA. From 1980 to 1981, I served as the Chair of the Committee on Privacy and Confidentiality; from 1989 to 1990, I served as the Program Chair of the Section on Survey Research Methods; and from 1995 to 2000, I served as the ASA's representative to the Research Industry Coalition. I also served as the President of the Research Industry Coalition from 1999 to 2000.

23. I have also held a number of positions with the AAPOR. From 1982 to 1989, I served as the Chair of the Conference Committee; from 1984 to 1985, I served as the Associate Secretary-Treasurer; from 1985 to 1986, I served as the Secretary-Treasurer; and in 1998, I served as the President of the Washington/Baltimore Chapter of AAPOR.

E. Compensation

24. I am being compensated for my work on this engagement at the rate of $525 per hour for my time. The payment of my fees is not contingent on the opinions I express in connection with this action.

F. Supporting Documentation

25. The documents on which I relied in forming my opinions are listed in Exhibit 2.

III. Summary of Opinions

26. Use of a statistically valid sample of loans allows the unbiased and precise estimation of the rate of false statements and omissions concerning the loan populations in the Prospectus Supplements filed with respect to each Securitization. I understand that FHFA

proposes to use sampling to establish the falsity of Defendants' statements in the Prospectus Supplements regarding (i) the number/percentage of loans that were collateralized by properties that were owner-occupied; (ii) the number/percentage of loans that had LTV ratios above specified values; and (iii) whether the loans were originated in compliance with applicable underwriting guidelines of the originators. *See*, e.g., Plaintiff FHFA's Proposed Sampling Protocol 5-6, Feb. 29, 2012.

27. The 16 FHFA Litigations involve 449 securitizations and 489 unique SLGs in 16 cases.

28. I selected a random sample of 100 loans from the SLGs supporting the certificates purchased by the GSEs in each Securitization, for a total of approximately 45,000 loans across the 16 separate cases.[4] These samples of loans are representative of the relevant Populations. This sample size will enable FHFA to estimate, per Population, at a 95 percent confidence level with a margin of error of at most plus or minus 10 percent, the percentage of loans as to which the Prospectus Supplements contained false statements, *e.g.*, based on representations as to owner occupancy, LTV, and/or compliance with a specific originator's underwriting guidelines. In all sample design projects, there is a tradeoff between what is ideal and what is feasible and practical under time pressures and cost constraints. I selected the sample size to achieve the 95 percent confidence level, which is standard in statistics, and a margin of error of, at maximum, 10 percent, because it is sufficiently precise for the purpose. Increasing the sample size to decrease the margin of error would also result in diminishing returns. *See infra* at ¶¶ 52-56.

29. I have also, where such data was available, stratified the sample by credit score to make it possible to further reduce the margin of error. Stratifying by additional variables would

[4] The loans comprising each sample are listed in Appendix 1.

not, however, meaningfully increase the chance that the margin of error could be reduced. *See infra* at ¶¶ 57-58.

30. Once the analysis of the loan files is complete, I will be able to extrapolate from the samples to the populations of the Securitizations using well-established methods.

IV. Background On Sampling

A. Key Concepts In Statistical Sampling: Confidence Level, Margin of Error, And Stratification

31. Statistical sampling is often referred to as "probability sampling." The population refers to the group about which we wish to draw inferences, and the sample is a defined subset of that population. When a sample is randomly selected—that is, when each member of the population from which the sample is drawn has a known chance of being included in the sample—the sample provides an unbiased view of the population.

32. The precision—or reliability—of a sample is measured using the confidence level and the margin of error. *See* Shari Seidman Diamond, *Reference Guide on Survey Research*, *in* Fed. Judicial Ctr., Reference Manual on Scientific Evidence 229, 243 (2nd ed. 2000) ("In all forms of probability sampling, each element in the relevant population has a known, nonzero probability of being included in the sample. Probability sampling offers two important advantages over other types of sampling. First, the sample can provide an unbiased estimate of the responses of all persons in the population from which the sample was drawn; that is, the expected value of the sample estimate is the population value being estimated. Second, the researcher can calculate a confidence interval that describes explicitly how reliable the sample estimate of the population is likely to be.").

33. The confidence level refers to the percentage of time that the actual value for the population will be within a specified range around the sample value. The margin of error refers

to that specified range around the estimated value from the sample. For example, if the results of testing on the sample indicates that 50 percent of the mortgage loans were not originated in accordance with underwriting guidelines, then a confidence level of 95 percent with a +/- 10 percent margin of error means that the statistical probability is 95 percent that the true percentage of loans not originated in accordance with underwriting guidelines in the population will be between 40 and 60 percent. This range is known as the confidence interval.

34. When a sample is used to test a binary question (here, whether a loan was originated outside of the guidelines, or the owner occupancy status of the underlying property or the LTV of the loan was misrepresented), the estimate of the margin of error depends on the sample value. The estimated margin of error (for a binary question) is greatest when the sample value is at 50 percent (here, for 50 percent of the loans in the sample, there were false statements or omissions in the Prospectus Supplements concerning owner occupancy, LTV ratio, or adherence to underwriting guidelines). As the sample estimate deviates from 50 percent, in either direction, the margin of error for that estimate decreases. This variation in margin of error, as sample estimate changes, is described further *infra* at Paragraphs 52 through 56.

35. Although a sample drawn purely at random from within a population is statistically valid, one can also draw a statistically valid sample using stratification. *See*, *e.g.*, Steven K. Thompson, *Sampling* 117-127 (2nd ed. 2002); Paul S. Levy & Stanley Lemeshow, *Sampling of Populations: Methods and Applications* 121-189 (3rd ed. 1999); William G. Cochran, *Sampling Techniques* 89-146 (3rd ed. 1977); W. Edwards Deming, *Sample Design in Business Research* 276-358, 487-493 (1960). Stratification is a process where the population of loans is divided into mutually exclusive and exhaustive subgroups of loans. Stratification can only be carried out using variables known for the entire population prior to sampling.

36. Stratification commonly is used in sampling for two purposes. The first purpose is to increase the precision of the estimates from the sample. What is calculated from the sample is an estimate of the value in the population. The estimate has a margin of error due to sample-by-sample variability, which is directly related to the variability of the data being examined. When using a stratified sample, this variability is partitioned into two parts. The first part is the variability between the strata, and the second part is the variability within each of the strata. Variability between strata is eliminated by forcing the sample into these separate subgroups *a priori*, leaving only the second part of the variability. Stratification does not guarantee a diminution in the margin of error; it makes the diminution possible. Defendants' expert has not opposed stratification for this purpose. *See* Barnett Decl. at ¶ 56 ("Because proportionately stratified random sampling might be useful to ensure representativeness, I have no general objections to its use here.").

37. The second purpose of stratification is inapplicable here. Stratification can ensure that some subgroups in the population are included in sufficient numbers so that it is possible to make separate estimates for each of the subgroups. This purpose of stratification does not apply here because the relevant inquiry instead is whether the Defendants made misrepresentations and omissions in the Prospectus Supplements for the Securitizations, not a subset of loans within those Securitizations.

B. Statistical Sampling Is Scientifically Valid

38. A wide body of peer-reviewed literature in the field of statistics discusses the utility of statistical sampling for making reliable estimates of parameters in large populations of entities. *See*, *e.g.*, Thompson, *supra*; Fed. Judicial Ctr., Reference Manual on Scientific Evidence (2nd ed. 2000); Levy & Lemeshow, *supra*; Dan M. Guy, D. R. Carmichael, & O. Ray Whittington, *Audit Sampling: An Introduction* (4th ed. 1998); Leslie Kish, *Statistical Design for*

Research (1987); Herbert Arkin, *Handbook of Sampling for Auditing and Accounting* (3rd ed. 1984); Statistical Sampling Subcommittee of American Institute of Certified Public Accountants, *Audit Sampling* (1983); Jaroslav Hájek, *Sampling from a Finite Population* (Václav Dupač & D.B. Owen eds., 1981); Cochran, *supra*; Des Raj, *Sampling Theory* (1968); Deming, *supra*; Price Waterhouse, *Audit Guidance Series: Audit Sampling* (1989).

39. In addition, statistical sampling has been used successfully for hundreds of years as a research tool. Results from statistical sampling are replicable, meaning that statistical sampling meets the basic requirements as a scientific method.

40. There have been numerous applications of statistical sampling in academia, business, and government. For example, the nation's largest statistical agency, the United States Census Bureau, is authorized to base its surveys, including those on the extent of unemployment and the cost of living index, on samples.

41. Statistical sampling has also been widely employed in the American legal system. I have testified in over 50 cases, and sampling was accepted as scientifically valid in each of those cases in which a sample was used. Outside of my personal experience, courts routinely approve the use of sampling in cases in which claims as diverse as breach of contract, fraud, antitrust, trademark infringement, or tort are at issue. One commentator has characterized the Census Bureau's reliance on sampling as a "great step forward" in "the law's gradual acceptance of sampling," because Census Bureau reports "were admissible at common law and in some states by special statutes." Hans Zeisel & David Kaye, *Prove it With Figures: Empirical Methods in Law and Litigation* 101 (1997). Shari Seidman Diamond, who authored the "Reference Guide on Survey Research," which is part of the Federal Judicial Center's *Reference Manual on Scientific Evidence*, has identified Census Bureau data and the Standard Table of

Mortality (used to present average life expectancy) as examples of sample surveys that "are so well accepted that they even may not be recognized as surveys." Shari Seidman Diamond, "Reference Guide on Survey Research," in *Reference Manual on Scientific Evidence* 359, 365 n. 18 (Fed. Jud. Ctr. 3d ed. 2011).

42. The development of statistical sampling is grounded in mathematics and is not focused on the type of entity being sampled, but instead applies universally across any entity that can be counted. The accepted techniques of statistical sampling are the same regardless of the population being sampled, whether they are widgets, tires, people, or loan files. This principle results in a truism regarding the precision of the sample: The precision of the sample can always be quantified when the methodology is random sampling and the sample is random. Indeed, the result of random sampling should be expressed only as a value accompanied by a confidence interval. Thus, it is as accurate to sample produce for spoilage as to sample loans for non-compliance with guidelines, and the sampling range in each case will be quantifiable and reviewable in the same way.

C. Statistical Sampling Has Been Used To Value and Assess Portfolios of Loans

43. Statistical sampling has been used by the government and private businesses to value and assess pools of loans.

44. Federal regulators, who are charged with examining loans and other activities at the financial institutions they regulate, look at a sample of loans, as it would be impracticable to examine the overwhelming volume of loans held by such an institution. For example, the FDIC routinely relies on statistical samples to examine a bank's compliance with statutory and regulatory requirements. As the FDIC describes in a manual published on its website, bank regulators use statistical sampling of a bank's loan portfolio to determine, among other things: (i) the bank's adherence to its own lending policies, (ii) the adequacy of the quality of the bank's

assets and collateral, (iii) whether the bank has charged the right interest rate and set aside the proper amount of reserves for the risk it faces. *See* F.D.I.C., *RMS Manual of Examination Policies* §§ 1.1 & 3.2 (2012), available at http://www.fdic.gov/regulations/safety/manual/index.html, a true and correct excerpt of which is attached as Exhibit 3. Thus, the FDIC's objective in using sampling is to determine whether risks in a pool of assets have been properly presented and priced.

45. Similarly, based on my other engagements in this industry, I understand that private businesses that purchase and securitize mortgage loans routinely use statistical sampling to price loan portfolios. Loan originators, underwriters and investment banks, and servicers may use sampling for these and other purposes:

- Loan originators generally require the use of sampling for quality control purposes when purchasing loans from third parties, such as correspondent banks. Loan originators often require the seller to conduct a quality control review of a sample of loans to ensure compliance with guidelines, as well as regulatory compliance.
- Underwriters and investment banks generally use sampling in fulfilling their due diligence obligations. More specifically, underwriters and investment banks rely on third-party due diligence firms to conduct credit and compliance reviews on random or adverse samples of loans selected from the pools of loans to be included in securitizations.
- Servicers generally use sampling to assess compliance with applicable servicing requirements.
- Experian, Transunion, and Equifax use sampling—specifically samples of loans taken from a small sample of banks—to create models to calculate credit scores.
- Financial institutions use sampling to conduct internal audit activities to ensure that transactions are correctly recorded as part of their quality control.

46. HUD has set forth quality control procedures and requirements for loan origination and servicing for FHA-insured loans. U.S. Dep't of Housing and Urban Dev., *Quality Control for Origination and Servicing Revisions to Mortgagee Letter 89-32* (May 26, 1993), a true and correct copy of which is attached as Exhibit 4.

V. Sampling Methodology Proposed

A. Purpose of Sample

47. As described above, FHFA proposes to use sampling to establish the falsity of Defendants' statements in the Prospectus Supplements regarding (i) the number/percentage of loans that were collateralized by properties that were owner-occupied; (ii) the number/percentage of loans that had LTV ratios above specified values; and (iii) whether the loans were originated in compliance with applicable underwriting guidelines of the originators. I further understand that FHFA will use the sample to enable it to estimate the percentage of loans in the population that contain misrepresentations as to one or more of these three attributes ("Defective Loans"). (*See, e.g.*, Pl. FHFA's Proposed Sampling Protocol 5-6, Feb. 29, 2012).

48. Based on my review of the loan tapes with respect each of the Securitizations, I understand that there are approximately 1,128,462 loans[5] in the SLGs for the Securitizations. I have been retained by FHFA in connection with this litigation to develop a methodology to select a statistically valid random sample of the relevant SLGs in each Securitization and to extrapolate the results to each Population.

B. Summary of Proposal

49. For each sample, I have selected 100 loans from the relevant SLGs for each Securitization. The sample size of 100 loans is sufficient to allow, for each Population, the computation of an estimate of different binomial (two category, such as defective or not) statistics with a reliability characterized by a 95 percent confidence level with a maximum margin of error of +/- 10 percent. I have further stratified the population by credit score, where possible, in selecting the sample, which may decrease the estimated margin of error.

[5] To the extent that any Defendants supply new loan tapes, this number may change slightly.

C. The Sample Is of Sufficient Size, And a Larger Sample Would Yield Diminishing Returns

50. I was instructed that the relevant populations are the SLGs for each Securitization. I have chosen to draw a sample of 100 loans for the relevant SLGs for each Securitization. I primarily used the loan tapes produced by the Defendants in discovery to select the samples of loans.[6] In some cases, these loan tapes contained incomplete data as to which loans were in the SLGs, and in others, there was no loan tape available. Where this was the case, I used data from CoreLogic, a widely recognized provider of financial data.[7]

51. This sample yields an estimate with a 95 percent confidence level at a maximum margin of error of +/- 10 percent.[8] I have further chosen to stratify each sample based on Fair Isaac Corporation ("FICO") score (where possible), which may increase the precision of the samples by reducing the margin of error.[9] These samples—whether stratified by FICO score or not—are sufficiently large to draw scientifically valid conclusions about each population.

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[6] For the *FHFA v. Ally Financial Inc.* case, certain data was obtained from loan tapes provided by Residential Capital LLC.

[7] For eight securitizations, there were a number of loans that lacked SLG information. These are identified in Appendix 2. Where there was no SLG information, I assumed the loan was not part of the SLG.

[8] The sample size necessary to achieve these results was 95. I rounded up to 100 out of an abundance of caution. This "oversampling" creates a cushion for my calculations and allows for some flexibility should, for example, a loan in a sample lack a loan file. I reserve the right to supplement samples, where necessary to achieve a sample size of approximately 100 loans or greater, using the same methodology outlined herein. For example, if a material number of loans do not have associated loan files, I may draw a supplemental sample.

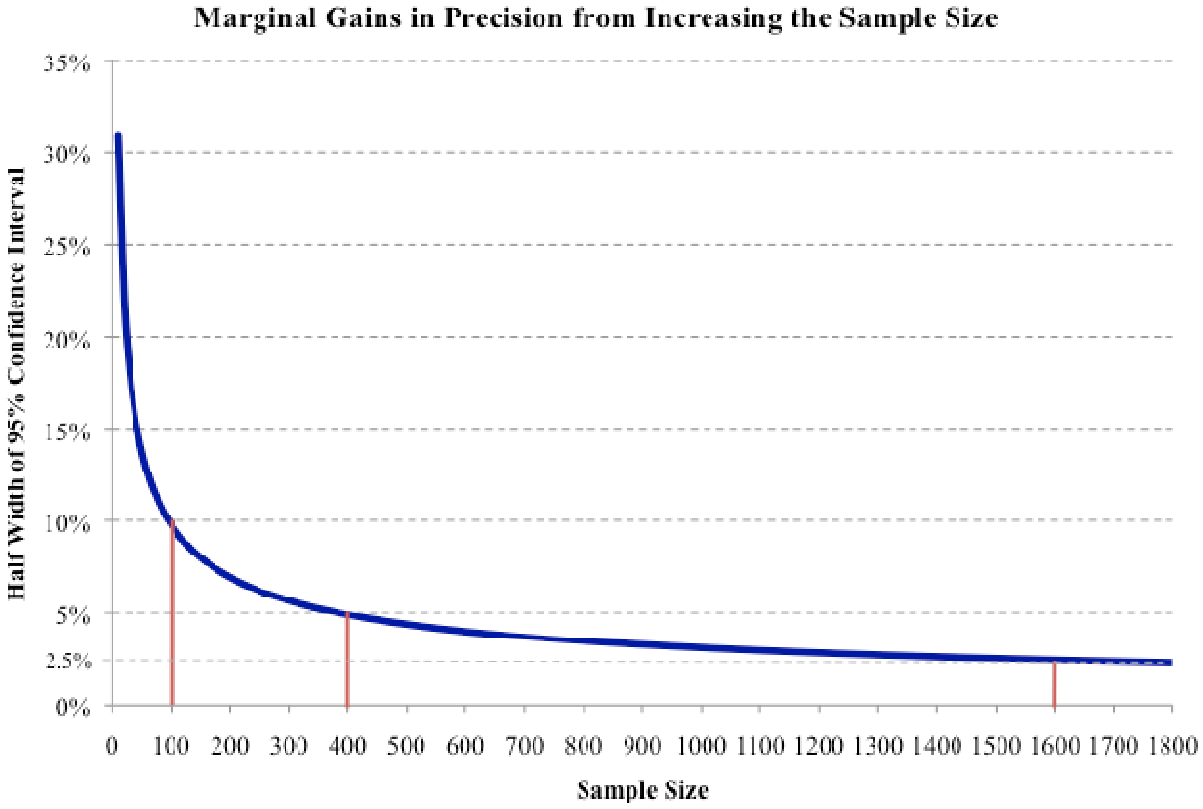
[9] Information as to FICO score was not available for two Securitizations, BAFC 2006-G and BAFC 2006-H, for which I drew a purely random sample by assigning a random number to every loan in the population and then selecting the 100 loans with the lowest random numbers. As the significance testing for these deals demonstrates, the resulting samples are representative of the populations.

1. A 95 Percent Confidence Level, With a Maximum Margin of Error of +/- 10 percent, Strikes the Correct Balance Between Cost and Accuracy

52. A 95 percent confidence level with a maximum margin of error of +/- 10 percent is scientifically valid. The confidence level of 95 percent is standard and well supported in statistics. *See* Kevin D. Hoover & Mark V. Siegler, *Sound and Fury: McCloskey and Significance Testing in Economics*, 15 J. Econ. Methodology 1, 13-14, 24 (March 2008) ("The critical value is typically but not always chosen to secure a 5% probability of type I error under the null hypothesis (i.e. a 5% size of the test)" and "…epidemiology or other areas of medical research … faithfully apply a standard of $p<0.05$ for reporting estimates"); Diamond, 2d ed., *supra*, at 244 ("Traditionally, scientists adopt the 95% level of confidence…"). Defendants' expert, Dr. Barnett, also agrees. *See* Barnett Decl. ¶ ¶ 13(c), 44.

53. The +/- 10 percent margin of error, with a 95 percent confidence level, strikes the correct balance between cost and accuracy for two primary reasons. The first reason that increasing sample size would generate only marginal benefits—without commensurate benefits in increased precision—is that the gain in reliability due to a larger sample size increases only as the square root of the sample size. This is demonstrated in Chart 1 below. As the sample size increases from 1 to 100, there is a large increase in reliability (meaning smaller confidence intervals for 95 percent confidence). As the sample size increases from 100 to 400, however, the increase in precision, and associated reduction in confidence interval, is only doubled. To halve the margin of error again, from plus or minus five percent to plus or minus 2.5 percent, the sample size has to quadruple again, from 400 to 1,600.

Chart 1: Diminishing Returns for Increasing Sample Sizes

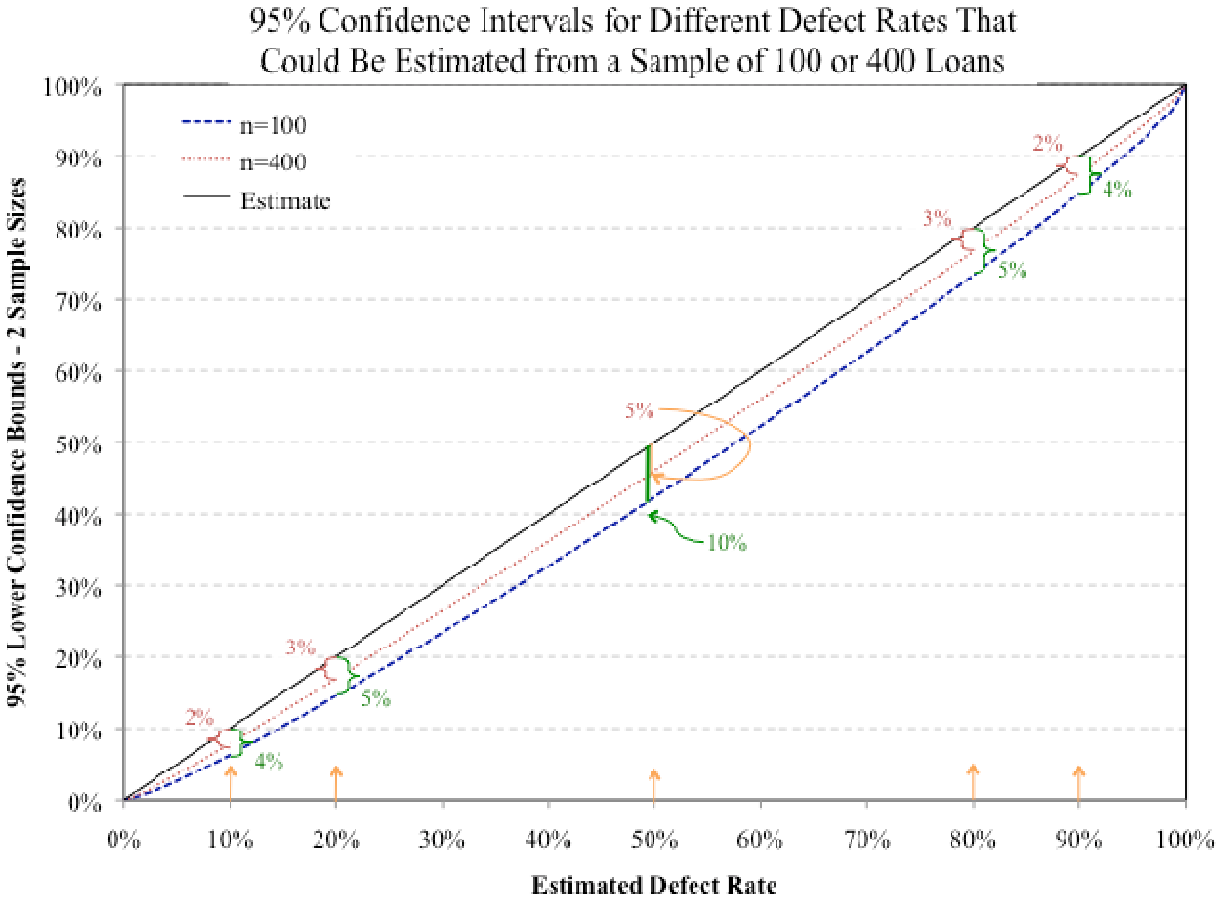


54. As shown in this chart, decreasing the margin of error below +/- 10 percent by increasing the sample size imposes large costs without commensurate benefits in increased precision.

55. The second reason that increasing sample size would generate only marginal benefits is that the +/- 10 percent is merely the maximum margin of error for this confidence level, and it occurs only when the estimated percentage of Defective Loans is 50 percent. Fifty percent is the scenario where variability is at its greatest: half Defective Loans and half not. When the variability decreases—that is, when the percentage deviates from 50 percent in either direction—the margin of error—and thus confidence interval—becomes smaller. As the intervals shrink, the marginal benefit of a larger sample size shrinks as well.

56. As the estimated defect rate deviates from 50 percent in either direction, the difference in confidence interval for samples of 100 and 400 decreases. This is shown in Chart 2 below, where the 95 percent lower bound confidence level for sample sizes of 100 and 400, corresponding to maximum margins of error of +/- 10 percent and +/- 5 percent, respectively, is shown for all possible percentages of Defective Loans, from zero to 100 percent. As Chart 2 demonstrates, quadrupling the sample size, from 100 to 400, does not yield a commensurate reduction in the 95 percent range across all possible percentages of Defective Loans. At 50 percent, or maximum variability, the range is +/- 10 percent for a sample size of 100 and +/- 5 percent for a sample size of 400. When the estimated rate is 20 or 80 percent, the 95 percent range for a sample size of 100 is +/- 5 percent, whereas for a sample size of 400 the 95 percent range is plus or minus 2.5 percent. When the estimated defect rate is 10 or 90 percent, the 95 percent range for a sample size of 100 is +/- 4 percent, while for a sample size of 400 it is +/- 2 percent. As the defect rate approaches zero, the 95 percent level must also approach zero, regardless of sample size. The same phenomenon symmetrically occurs for the corresponding values above 50 percent, as shown in Chart 2.

Chart 2: 95% Lower Bound For Samples Of Size 100 And 400 For All Defect Rates



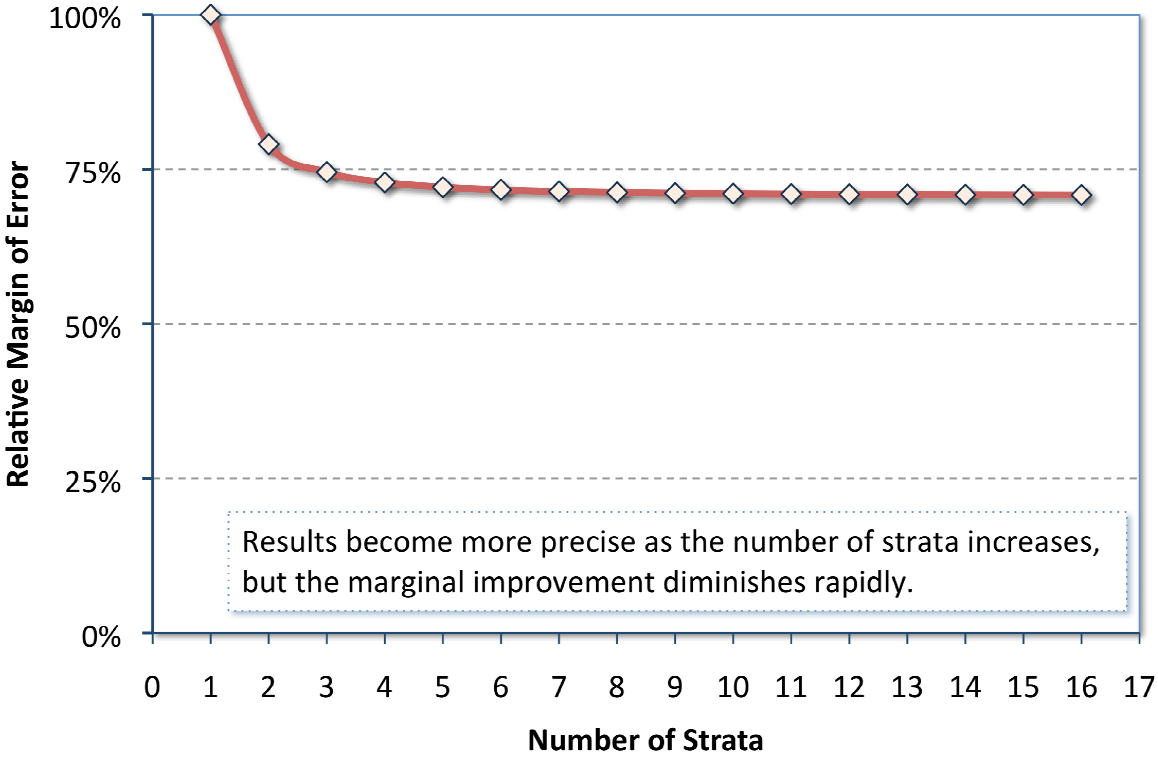
2. Stratification by FICO Score May Increase The Precision of The Estimate

57. The only variable I used to stratify the loan pools is the borrower's credit score, specifically the score as reported by the Fair Isaac Corporation (the "FICO score"), which generally appears for each loan on the loan tapes produced by the Defendants for the Securitizations. A borrower's FICO score can range from 350 to 850. A credit score is a number representing the creditworthiness of a person or the likelihood that person will pay his or her debts. It has shown to be predictive of risk. In my experience, lenders, including mortgage loan originators, use credit scores to determine who qualifies for a loan, at what interest rate, and to what credit limits. In addition, in my experience, a borrower's credit score is highly unlikely to be misstated on a loan tape (unlike, for example, other loan tape data such as the loan-to-

value, or LTV, ratio), and is correlated with other factors that could be used as stratification variables. Thus, the benefit of stratifying using variables in addition to FICO would be diminished.

58. Although there are other factors available for stratification from the loan tapes, it is reasonable to limit the number of variables used to stratify the population. First, there are diminishing returns to reductions in the margin of error that result from adding more stratification variables. As the number of stratification variables increases, the margin of error tends to decrease, but at a slower and slower rate, until there are only very marginal reductions. Second, these decreases in the margin of error may not materialize if the stratifying variable is not correlated to outcomes of interest or if some of the subgroups created by the stratifying variables are empty (as I found to be the case when assessing the possibility of using the loan originator as a stratifying variable and then sampling proportionally by vintage of the loan). Thus, there may be no benefit to stratifying by additional variables if the goal is simply to increase the number of strata without regard to the ultimate goal, which is reduction of the margin of error. The chart below illustrates the diminishing returns associated with increasing the number of strata in an effort to increase precision.

Chart 3: Potential Reduction in Margin of Error and Diminishing Returns from Use of Additional Strata



Example from Cochran, Sampling Techniques. Correlation of strata with outcome is 0.5. Correlations can be 0.0 to 1.0.

59. Using FICO score as a stratifying variable, I have divided the population of loans in each securitization into four equally sized groups with very low, somewhat low, somewhat high, and high credit scores defining the groups. Because I have sampled each of the Securitizations separately, the set of strata boundaries that define where one bucket ends and where the next begins (three strata boundaries define the four buckets in each securitization) will differ from Securitization to Securitization. This will not be an issue for estimation from each sample, since the estimates are derived separately for each Securitization, adding up across all the strata.

60. There are four strata created from credit score. Each stratum has the roughly same number of loans. A random number is generated for each loan in each stratum, in a manner that ensures that each loan has an equal chance of being selected. After the random numbers are

assigned, the loans are reordered (sorted) from lowest to highest random number. The first 25 loans in each stratum are selected to be in the sample, yielding 100 loans per Securitization in each of the Securitizations.

3. The Sample Is Random And Unbiased

61. The methodology described above for selecting a sample of loans from each Securitization ensures that the sample is random and not subject to manipulation. *See, e.g.,* Thompson, *supra*, at 117-127; Levy & Lemeshow, *supra*, at 121-189; Cochran, *supra*, at 89-146; Deming, *supra*, at 276-358, 487-93.

62. To ensure that the sample selected is representative of the population from which it was selected, I tested the sample against the population on eleven key variables (when available) from the loan tapes: FICO score, debt-to-income ratio, LTV ratio, CLTV ratio, note rate, loan amount, original term, documentation type, occupancy type, property type, and loan purpose.[10] For continuous variables (those where the values are numeric and increasing or decreasing in value, like FICO score and LTV ratio), I compared the mean of the sample distribution to the mean of the population distribution using a z-test, which is a common statistical method for determining that a sample value could have come from the population. For categorical variables (those where the values are categories, such as documentation type), I compared the distribution of the categories in the sample to the distribution of the categories in the population using a Chi-square test. Again, this is a common statistical method for determining that a sample distribution could have come from the population. At a 5 percent or less level of significance, I would expect 1 in 20 (5 percent) of the tests to fail by chance. The

[10] Not all eleven variables were available for each Securitization. This is indicated in Appendix 2.

results of these tests are listed in Appendix 2. These results indicate a very high level of correspondence between the samples and their populations.

D. Extrapolation from Results of Re-Underwriting Sampled Loans to Population Is Straightforward

63. There are several statistically valid methods of extrapolating the results of the tests conducted on the samples to the populations of loans. The actual method to be used depends on the availability of data and the relationships between the variables in the sample. As such, the determination of which method to use depends on the results of the testing on the samples. Nonetheless, any of the methods presented below may potentially be used in this action, and the method that will ultimately be selected will be the one that minimizes the margin of error. Because the selection of the method depends on which method reduces the margin of error the most, it is a relatively straightforward and uncontroversial process.

64. Once the samples of loans have been reviewed and determinations are made regarding each of the inquiries as set forth above in Paragraph 47, the next step is to extrapolate the results of such testing on the samples to the population of loans. It is meaningless to draw a sample from a population if there is no considered way to extrapolate the results from that sample to the population. The process of extrapolation of the results from the sample to the population is an integral part of the planning for and acceptance of sampling as a viable scientific method.

65. Extrapolation refers to the concept of using the results from the sample to estimate the values or differences in the population. For example, extrapolation refers to the process of using the number of Defective Loans in each sample to estimate the total number of Defective Loans in each Population.

66. Statistical sampling also allows one to determine the precision of each estimate by computing a confidence level and margin of error for each estimate. As explained above, a 95 percent confidence level is the range in which one can be confident that, if the process were repeated a very large number of times, the true population value would be found inside that range 95 percent of the time. From this computation, it is possible to determine a value where there would be only a small percentage chance that the population value would be lower. If there is a 95 percent chance that the true value is in the range, there is only a 2.5 percent chance that the true value is below the range, and a 2.5 percent chance that the true value is above the range.

67. By way of an example, assume that 50 percent of the mortgage loans in the population were defective. Using a confidence level of 95 percent with a margin of error of +/- 10 percent, if 100 different samples of 100 loans were selected, in approximately 95 of those 100 samples, the confidence interval will include 50 percent.

68. For each method of sampling that might be considered, there is a multitude of ways that the results from the sample can be extrapolated to the population. For a simple random sample, it is the randomness of the sample that allows us to make a simple assumption: Relationships in the sample are like relationships that exist in the population.

69. The first extrapolation method assumes that relationships for numbers of loans in the sample are like relationships for numbers of loans in the population. A simple equation of this assumption is as follows:

$$\frac{\text{Number of defective loans in sample}}{\text{Total number of loans in the sample}} = \frac{\text{Number of defective loans in population}}{\text{Total number of loans in the population}}$$

70. In this relationship, three of the four numbers are known: (i) the number of loans in the sample that are defective; (ii) the total number of loans in the sample; and (iii) the total

number of loans in the population. Solving the equation for the fourth number—the number of loans in the population that are defective—is simple. The mechanism of randomization allows us to assume that the ratio on the right for the population is like the ratio on the left for the sample.

71. With simple random samples selected in these matters, one can calculate the proportion of loans in the sample that are defective. This proportion is an estimate of the proportion of Defective Loans in the population. Multiplying this proportion by the total number of loans in a Securitization provides an estimate of the number of Defective Loans in the population.

72. For a stratified random sample, the same assumption is made, but specifically within each stratum in the population, and an extrapolation is made in each stratum separately. The sample estimate from a stratified random sample is the sum (or average, depending on the type of estimate) of estimates from the individual strata. For a stratified sample, with a simple random sample selected within each stratum, the process described in the previous paragraph is repeated within each of the strata. The estimated number of Defective Loans within each stratum is summed over all strata to give an estimate of the number of Defective Loans in the population.

73. Accordingly, it will be possible for the fact finder to determine liability for any one Securitization with a known level of accuracy because of the existence of the confidence level and the margin of error. It also will be possible for the fact finder to determine liability for the combined set of Securitizations in any particular case with a much higher level of confidence. The Securitizations are sampled independently, and one can sum the estimated total number of breaches across all Securitizations for a specific case.

VI. Conclusion

74. For the reasons set forth above, a sample of 100 loans per Population will be sufficiently large to provide a scientifically reliable estimate of the number Defective Loans in the those Populations.

Declared under penalty of perjury
this 10th day of October 2012

CHARLES D. COWAN, Ph.D.